ON THE TEETH OF MAZODUS.

E. W. CLAYPOLE, B. A., D. Sc., F. G. S, Akron, Ohio.

On the top of the Berea grit, as it occurs at Berea, lie about twenty feet of very dark shale, in which occurs a great profusion of certain fossils, especially *Lingula melie* and *Discina Newberryi*. With these are some fish remains, and in the lowest portion are the large, flat, pavement teeth which were named *Mazodus* by Dr. Newberry in his Paleozoic Fishes of North America. They evidently formed the mouth armor of some paleozoic shark of comparatively large size, some of the teeth exceeding two inches in diameter.

The great size and good condition of these teeth, which are all that we yet know with certainty of the fish, render them good material for microscopical investigation, and I propose in this note to give the results of my examination so far as it has yet gone.

The vertical section of the tooth shows a loose mineral structure permeated by canals, presenting the same appearance as those in bone. They run, on the whole, vertically through the tooth, but branch and anastomose with such frequency that the whole structure is penetrated or honeycombed with them. Radiating obliquely from these into the solid tissue are numerous canaliculi running in directions determined by that of the section and branching as they diverge from the canal and from each other.

No lacunæ are present and if the canaliculi anastomose they unite with those coming from other canals—a structure quite common in the teeth of fishes.

In the lower portion of the tooth the direction of the canals is so irregular that little appearance of parallelism can

be detected. The base has a loose spongy texture, gradually becoming more firm and regular upwards.

Traces can be seen in the lower part of the tooth of an irregular laminated structure in the solid matter, like that in the Haversian system of bone, but toward the summit the structure becomes much more regular and the somewhat wavy striation of dentine is evident. Through this dentine, however, the canals extend with nearly the same frequency as below, and the radiating canaliculi accompany them everywhere. This portion of the tooth has been less deeply stained during mineralisation, and thereby betrays a denser nature than that of the lower portion.

Mazodus, therefore, presents a structure very like that of *Cladodus*, which I described in a paper before this society at Madison, in 1893. It shows what we may call a dentary tissue, which is not the differentiated tissue composing the teeth of the higher animals, and which does not show even a well marked dentine, though an approximation to that form of tissue is discernible. But the passage of the canals through it makes its appearance very different from that of typical dentine.

It is further to be noted that as the canals run completely through this outer layer they open on the external surface of the tooth, where their mouths give a pitted appearance to the fossil, often visible without a lens. It is not easy to correlate them, therefore, with Haversian canals, which are always lined with periosteal membrane and never detail upon an external surface. What purpose was accomplished by their presence in the superficial layer it is not easy to see. The teeth seldom show signs of great use, though their purpose was probably the crushing of shells, a task likely to wear or even to break them. Deep scratches, however, are not uncommon. They were not, probably, renewable after loss or injury, as are the cutting teeth of the sharks, and hence their loose and spongy structure is the more remarkable.

The teeth present no trace of enamel, nor have I found any substance deserving the name on any paleozoic tooth

that I have examined. Should this be generally true, then the introduction of the hardest material in the animal body is of comparatively late date. At the same time, its absence would indicate some difference in the development of the teeth, for the enamel is a product of the ectodermic layer, while the dentine and its analogue are of mesodermic origin.

It would then follow that the involution of the ectoderm by the development of the enamel organ did not take place among the early sharks.

The literature within my reach does not enable me to ascertain how far investigation has proceeded into the history of the evolution of the teeth in existing sharks. This matter has received much attention among the higher animals, but our knowledge of dental evolution and development in fishes is as yet very incomplete.

The facts here given show that Dr. Newberry's original description needs a slight correction if his words are interpreted in their strict sense. He says: "They (the teeth of *Mazodus*) are composed of dense enamel-like tissue throughout, with no division into crown and base, one enamel and the other bone, such as we find in all known crushing teeth of elasmobranch fishes." So far from being "enamel-like," save perhaps superficially to the naked eye, these teeth are composed of a very spongy dentinal tissue, whose traversing canals reach to the very surface, and which, therefore, differs radically from the close, fine, crystalline structure of real enamel. And further, so far from being an exception to the rule among elasmobranch fishes, they are in full accord with it. In whatever cases I have examined the teeth of fossil sharks I have found them uniformly composed of this loose, unenamelline tissue and a true enamel conspicuously absent. I need scarcely add that this remark refers to paleozoic times only.

FIG. I.

Mazodus tooth.

Transverse section, showing canals and canaliculi.

FIG. II.

Mazodus tooth.

Longitudinal section, showing dentine and canals.

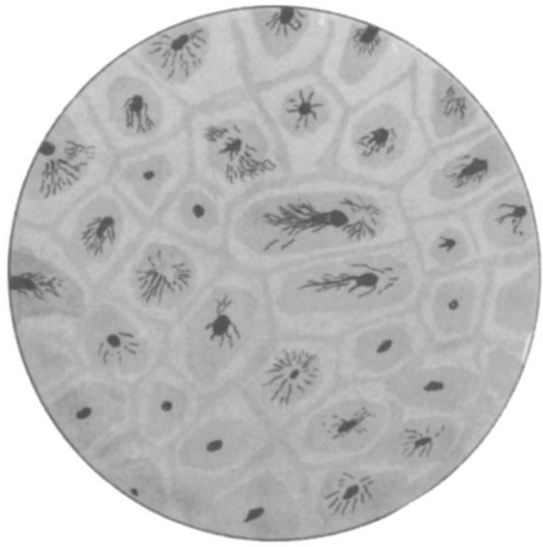

Fig 1.

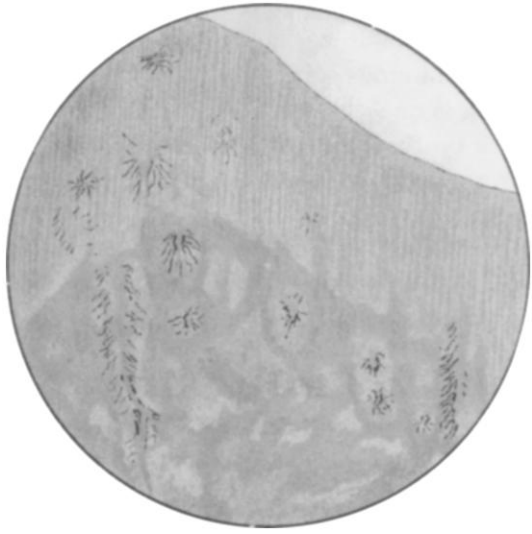

Fig 2.